VSD Fan Control

California Building Energy Efficiency Standards
Revisions for July 2003 Adoption

November 5, 2001

Description

Electronic variable-speed drives (VSDs) for VAV systems are now highly reliable and relatively inexpensive in all sizes. The existing Standards require mechanical or electrical VSDs for fans above 25 horsepower that do not have good unloading characteristics (airfoil and backward inclined), but otherwise allow any unloading mechanism (inlet vanes, etc). Fans below 25 horsepower do not have any unloading requirements.

The Standards should consider requiring VSDs, or equivalent unloading mechanisms, for all VAV systems, regardless of horsepower.

Benefits

In many VAV systems, fans may use as much energy on an annual basis as the cooling compressors. Reducing the fan energy via VSDs is one of the most cost-effective measures in reducing HVAC system energy.

Time dependent valuation would reduce the benefits of this measure, as the energy savings will accrue principally in the non-peak hours. However, since engineers normally apply a safety factor to their load calculations, savings during on-peak periods are also expected. In fact, this technology allows reasonably oversized fan systems to operate more efficiently than equipment sized to exactly meet the load.

Environmental Impact

VSDs can create harmonic distortion on power lines, which can affect sensitive electronic equipment and can reduce the power factor of a building. These effects are commonly mitigated using filters.

While VAV systems may have an effect on indoor air quality, VSDs do not increase this effect.

The manufacture of VSDs shares the same environmental considerations as the electronic industry in general.

Type of Change

Prescriptive Requirement	The change would add or modify a prescriptive requirement. Prescriptive requirements must be met for prescriptive compliance and define the Standards baseline building in performance calculations, but are not mandatory when the performance approach is used.

The proposed change modifies the existing scope of the standards, eliminating the less-efficient unloading mechanisms (such as inlet vanes) for systems larger than 25 horsepower, and extending the same requirements to systems of less than 25 horsepower.

This change would affect all documents: Standards, ACM, manuals, and compliance forms.

Measure Availability and Cost

Electronic VSDs have been available for over 15 years, are now considered highly reliable, and the manufacturers are well-known to HVAC designers and mechanical contractors.

Given the lead time between adoption and enforcement, manufacturers should be quite capable of meeting the demand. For built-up systems there should be no significant problems in accommodating VSDs in the controls. For packaged-rooftop equipment, manufacturers may require more lead time to re-engineer their cabinets to accommodate the VSD.

For life cycle cost analysis, the baseline conditions would be current Standards.

The cost varies by size, with larger sizes costing less per horsepower than smaller sizes. The contractor cost (uninstalled) ranges from $800 for a 10 horsepower VSD to $2,800 for a 50 horsepower drive. Net installed cost, including control points and commissioning, ranges from $2,050 to $5,680 respectively. Manufacturer's warranties are typically 2 years parts and labor. Of the above costs, commissioning is about $200.

Useful Life, Persistence and Maintenance

VSDs have matured considerably over the last 10 years, and the technology is different than it was 10 years ago. The currently generation of drives is expected to last at least 10 years, but is too new to have been demonstrated for that period.

Energy savings will be consistent over the life of the drive.

Performance Verification

The installation requirements of VSDs are well understood by electrical engineers and controls contractors. The most critical aspects in commissioning the device are:

1. Verification to ensure that the unit is installed in accordance with manufacturers recommendations,
2. The static pressure sensor is installed at a representative location in the ductwork, and the required setpoint is specified by the HVAC engineer.
3. Many DDC systems can achieve additional savings by dynamically resetting the static pressure setpoint based on the worst-case VAV box..

Cost Effectiveness

Numerous *Savings by Design* DOE-2 studies for Southern California Edison, as well as others, indicate that VSD fan control has a typical payback of 2-3 years.

Analysis Tools

All common commercial building energy simulation programs have the capability of simulating VSD fans. Included are DOE-2, BLAST, Trace, and HAP.

Relationship to Other Measures

No other measures are impacted by this change.

Bibliography and Other Research

VSD fan control is a very common measure analyzed in the *Savings by Design* programs of California's investor-owned utilities.

This measure is proposed based on the personal design experiences of J. Hirsch & Associates. Currently, this submittal is intended as a place holder to identify this topic as a subject that the Standards do not address. Significant further study will be required to develop the proposed regulations; however no funding source for this study has been identified.